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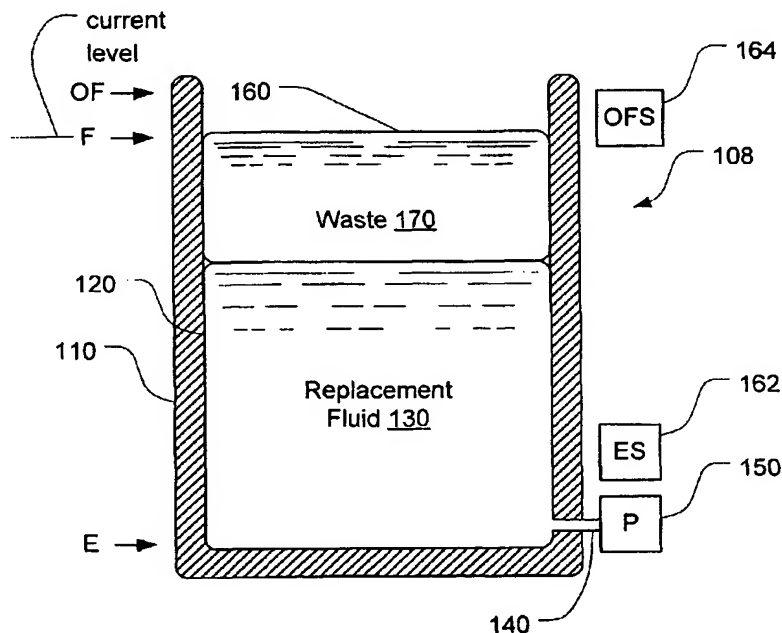
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[Continued on next page]

(54) Title: WASTE BALANCING FOR EXTRACORPOREAL BLOOD TREATMENT SYSTEMS



(57) Abstract: One or more waste balancing systems (108) may be used in a fluid circulating system for medical use. The fluid circulating system may be part of a blood treatment system for a patient suffering renal failure. A waste balancing system may include a pressure element operable to maintain a constant fluid pressure created by the combined weight of waste removed (170) from a patient and replacement fluid (130) for providing to a patient. Multiple evaluation characteristics or control parameters may be evaluated or controlled for safety and accuracy. At least part of the waste balancing system may be incorporated into a disposable cartridge.



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AMENDED CLAIMS

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original claims 1 and 4 amended]**

1. A waste-balancing system for a hemofiltration system, the waste-balancing system comprising:

a scale configured to detect a patient weight of a patient undergoing treatment by the hemofiltration system, the scale detecting the patient weight during the treatment;

a source of replacement fluid;

a pump in fluid communication with the source and the patient;

a sensor to indicate a waste characteristic of waste removed from the patient by the hemofiltration system;

a controller being operatively coupled to the scale and the pump; and

said controller being configured to determine, from at least the patient weight and the waste characteristic, an optimal amount of replacement fluid to be provided to the patient during the treatment and to control the pump to provide the optimal amount of replacement fluid to the patient during the treatment.

2. The waste balancing system of claim 1 wherein the sensor includes a flow meter.

3. The waste balancing system of claim 2 further comprising a buffer to accumulate waste upstream of the flow meter.

4. A waste balancing system for a blood treatment system, comprising:

a scale configured to detect a weight of a patient undergoing treatment by the blood treatment system;

a replacement fluid regulator connected between a replacement fluid supply and a patient to supply replacement fluid to the patient;

said replacement fluid regulator being configured to maintain a balance between a total amount of fluid flowing into a treatment apparatus and the patient's body and a total amount of fluid flowing out of a treatment apparatus and the patient's body;

and a controller operatively coupled to the scale and to the regulator, the controller being configured to control the regulator responsively to a weight indication from the scale, whereby systematic error in the replacement fluid regulator is compensated by the detected weight of the patient.

5. A waste balancing system for a hemofiltration system, the waste balancing system comprising:

a fluid circuit with a fixed-volume chamber;

a waste container and a replacement fluid container disposed in and fully occupying the fixed-volume chamber;

a waste conduit adapted to connect the waste container to a hemofilter;

a replacement fluid conduit adapted to connect the replacement fluid bag to a patient such that adding a volume of waste to the waste container causes an equal volume of replacement fluid to exit the replacement fluid container; and

a weight sensor configured to indicate a weight of at least the waste container;

and a controller configured to adjust the rate of flow of waste responsively to an indication of said weight sensor.

6. The waste balancing system of claim 5 wherein the weight sensor includes a fluid pressure element capable of sensing a fluid pressure caused by a combined weight of the waste container and the replacement fluid container.

7. The waste balancing system of claim 7 wherein the weight sensor means includes a scale arranged to detect the combined weight of the waste container and the replacement fluid container.

8. The waste balancing system of claim 5 wherein the weight sensor includes a scale arranged to detect the weight of the fixed-volume chamber.

9. A tandem waste balancing system for providing continuous replacement fluid availability to a patient undergoing treatment by a blood treatment system, the tandem waste balancing system comprising:

a first balancing chamber comprising : a first waste compartment for receiving waste from the blood treatment system;

a first replacement fluid compartment for providing replacement fluid to the patient undergoing treatment by the blood treatment system;

and first weight sensor configured to detect a weight of the first balancing chamber;

a second balancing chamber comprising: a second waste compartment for receiving waste from the blood treatment system;

a second replacement fluid compartment for providing replacement fluid to the patient undergoing treatment by the blood treatment system;

and a second weight sensor configured to detect a weight of the second balancing chamber;

a controller configured to control a flow of replacement fluid from the first replacement fluid compartment based at least on the detected weight of the first balancing chamber;

and said controller being further configured to control a flow of replacement fluid from the second replacement fluid compartment based at least on the detected weight of the second balancing chamber.

10. The tandem waste balancing system of claim 9 wherein the first weight sensor includes a scale.

11. The tandem waste balancing system of claim 10 wherein the first controller includes a microprocessor.

12. The tandem waste balancing system of claim 9 wherein the first weight sensor includes a pressure element effective to sense fluid pressure.

13. The tandem waste balancing system of claim 12 wherein the pressure element includes a pressure transducer located to measure pressure of one of said waste and replacement fluid within a respective one of said chambers.

14. The tandem waste balancing system of claim 9 wherein the first waste compartment comprises a first flexible bag and the first replacement fluid compartment comprises a second flexible bag.

15. The tandem waste balancing system of claim 9 wherein the first balancing chamber further comprises a divider separating the first waste compartment from the first replacement fluid compartment.

16. The tandem waste balancing system of claim 15 wherein the divider comprises a piston.

17. The tandem waste balancing system of claim 15 wherein the divider comprises a portion of the first waste compartment fused to a portion of the first replacement fluid compartment.

18. The tandem waste balancing system of claim 9 wherein the first balancing chamber operates in a cycle opposite the second balancing chamber.

19. A waste balancing system for medical use comprising:

first container containing a fluid waste;

second container containing a replacement fluid;

a support supporting the first and second containers in a stacked relationship; and

a pressure sensor in pressure communication with at least one of the first and second containers;

a controller connected to control a pump and to receive a signal from said pressure sensor and control a rate of flow of at least one of said fluid waste and said replacement fluid to and from said first and second containers responsively to said signal.

20. The waste balancing system of claim 19 further comprising a detector configured to detect an emptying of one of said first and second containers, said controller being configured to control said flow responsively to said detector.

21. The waste balancing system of claim 19 wherein the first container is stacked on top of the second container.

22. The waste balancing system of claim 19 wherein the pressure sensor is adjustable.

23. A blood treatment system comprising: blood treatment means for clearing a patient's blood of toxins;

a fluid balancing system comprising: first container means containing a fluid waste;

second container means containing a replacement fluid;

a support supporting the first and second containers in cooperating relationship such that a pressure in at least one of said first and second containers is indicative of a combined weight of said first and second containers with their respective contents;

a pressure sensor in pressure communication with at least one of the first and second containers;

a blood treatment machine and a conduit connectable to the blood treatment machine;

and a controller configured to control a rate of flow of replacement fluid responsively to the pressure sensor.

24. The blood treatment system of claim 23 wherein the blood treatment machine comprises a hemofilter.

25. The blood treatment system of claim 23 wherein the blood treatment machine comprises a dialyzer.

26. The blood treatment system of claim 23 further comprising a removable disposable cartridge containing at least part of the first container as an integral part of the removable disposable cartridge.

27. The waste balancing system of claim 23 wherein the first container includes an expandable container.

28. The waste balancing system of claim 23 further comprising a piston separating the first and second containers.

24. A multiple balancing system comprising:

a first waste balancing system comprising:

first container means for containing a fluid waste;

second container means for containing a replacement fluid;

and first pressure means in fluid communication with the second container means for maintaining a fluid pressure;

and a second waste balancing system comprising: third container means for containing a fluid waste;

fourth container means for containing a replacement fluid;

and second pressure means in fluid communication with the fifth container means for maintaining a fluid pressure;

wherein the first and third container means are connectable to a common waste dump;

and wherein the second and fourth container means are connectable to a common source of replacement fluid.

25. The multiple balancing system of claim 24 wherein the first container means is positioned on top of the second container means in stacked relationship.

26. The multiple balancing system of claim 25 wherein the first container means is expandable.

27. The multiple balancing system of claim 24 wherein the first and second container means are separated by a piston.

28. The multiple balancing system of claim 24 further comprising sensor means for sensing when the second container means is substantially empty.

29. A method for an electronic controller in a blood treatment system, the method comprising:

selecting an evaluation characteristic for evaluating waste removed from a patient by the blood treatment system;

evaluating the waste according to the selected evaluation characteristic;

selecting, based at least on the evaluating, a control characteristic for controlling a system for supplying replacement fluid to the patient;

determining, based at least on the evaluating, a desired result in terms of the control characteristic;

controlling to achieve the desired result during treatment of the patient by the blood treatment system.

30. The method of claim 29 wherein the selected control characteristic comprises an On/Off control of the blood treatment system.

31. The method of claim 29 wherein the selected control characteristic comprises an On/Off control of the system for supplying replacement fluid to the patient.

32. A method for a blood treatment system, the method comprising:

selecting a plurality of evaluation characteristics for evaluating waste removed from a patient by the blood treatment system;

evaluating the waste according to the selected evaluation characteristics;

selecting a plurality of control characteristics for controlling a system for supplying replacement fluid to the patient;

determining, based at least on the evaluating, a desired result in terms of the control characteristics;

controlling the system for supplying replacement fluid to achieve the desired result during treatment of the patient by the blood treatment system.

33. The method of claim 32 further comprising selecting an evaluation characteristic based on the evaluating.

34. The method of claim 32 further comprising indicating an alarm condition to a remote location.